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Hypertext Document Viewing Tool Trade Study: Summary of Evaluation Results

Technical Paper

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Abstract

This Technical Paper documents the Hypertext Document Viewing Tool trade study defined in DID 211, Trade-off Studies Analysis Data for the ECS project. The trade study was accomplished by evaluating the currently (Spring, 1995) available Graphical Web browsers running on UNIX/X Window. The evaluation criteria, process, and results are described in detail. Two different methods were used to analyze the evaluation data that led to slightly different results. However, the best tool in both methods was the same: Netscape.

This trade study was a joint project by ECS and University of Maryland at College Park (UMCP). UMCP provided technical expertise on OTSO, a systematic process for reusable software component selection; ECS performed searching of tools, and conducted hands-on evaluation. Criteria definition and results analyses were performed by both parties. Jyrki Kontio, UMCP, is the primary author of this document.

Keywords: browser, hypertext, HTML, World Wide Web, COTS, tool evaluation, multiple criteria decision analysis, AHP.

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1. Introduction

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1.1 Purpose

The purposes of the Hypertext Viewing Tool trade study were: 1) to find a hypertext viewer for use as part of the Client Workbench for displaying HTML documents; 2) to provide general access for Client users to the World Wide Web; 3) to serve as the implementation mechanism for the Client's hypertext based user interface.

1.2 Organization

This paper is organized as follows:

Chapter 2 contains an overall description of the selection process and rationales of the decisions made.

Chapter 3 and appendix B present the evaluation criteria used in this study.

Chapter 4 presents the results of the hands-on tool evaluations. These are qualitative descriptions of how each tool corresponds to the evaluation test used and how they differ from each other.

Chapter 5 presents the results of the two analysis methods used to rank the alternatives, based on the evaluation data.

Chapter 6 presents summary and conclusions of the evaluation and analysis process.

1.3 Review and Approval

This Technical Paper is an informal document for internal distribution approved at the Office Manager level. It does not require formal Government review or approval; however, it is submitted with the intent that review and comments will be forthcoming.

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1.4 Applicable and Reference Documents

211-CD-001-001 Trade-off Studies Analysis Data for the ECS Project, Feb 1995.

CS-TR-3478 Kontio, J.: *OTSO: A Systematic Process for Reusable Software component Selection*. University of Maryland Technical Reports, College Park, MD, University of Maryland, 1995.

2. Evaluation Process

The selection process is explained in a separate document in more detail (Kontio, 1995). The main phases and their results are described below.

2.1 Search

A total of over 48 tools were found during the search for possible tools. The search was done using the WWW, as we assumed that these tools would be on the Web. The following distribution of tools by platforms X Window (17), Text-mode (4); MS Windows (16), MS DOS (1); Macintosh (4); Others (6). Appendix C contains a full list of these tools with pointers to further information about them.

2.2 Screening

Out of the total number of Web browsers found, four were selected based on the following screening criteria:

- HTML level 2 compatibility: the tool should support HTML level 2
- Availability on the Unix platform
- Popularity of the tool: the tool should be one of the most widely used tools
- Availability: a working version of the tool must be available

The selected tools were

Mosaic for X	The most popular WWW browser. A shareware product, version 2.4
Netscape	A popular WWW browser, version 1.1b3.
Webworks for Mosaic	A commercial, tailorable WWW browser, version 1.5.
HotJava	A prototype of a commercial tool with an internal programming language that allows executable contents, version 1.0a2.

The DCE Web browser, Ariadne, by OSF was also considered but not selected because it is not yet available.

2.3 Evaluation

The detailed evaluation of the tools selected was based on a set of hierarchical criteria and rather detailed definitions for each criterion. The evaluation “phase”, as represented here, also included the definition of the evaluation criteria. The actual evaluations consisted of a set of “tests” that corresponded to the criteria.

The explicit and detailed definition of the criteria allowed a consistent evaluation of the tools even though several evaluators were involved. Each tool was evaluated by two evaluators and they each wrote a report that described how the tool compared to the tests. The rationale for redundancy in evaluation was to improve consistency in evaluations.

Evaluation results were discussed in a meeting where all evaluators were present (one was represented by a proxy). Most of the conflicting observations and open issues were resolved in the meeting and the remaining ones were solved through assigned action items.

The meeting also changes the definitions of two evaluation criteria tests and some of the tests were dropped as the data was not available. The evaluators also found that some of the evaluation test definitions still were too general and were thus not well understood.

The evaluation data is presented in chapter 3. Table 2-1 presents which individuals participated in the evaluation and the responsibilities they had.

Table 2-1: Participants and their responsibilities

Name	Responsibilities
Kontio, Jyrki (UMCP)	Screening; Criteria Definition; Analysis/WSM; analysis/AHP; Mgmt/Admin
Chen, Show-Fune	Search; Screening; Criteria Definition; Evaluation (Webworks, HotJava); Analysis/WSM; Analysis/AHP; Mgmt/Admin; Others
Hung, Jerry	Screening; Criteria Definition; Mgmt/Admin
Kumar, Sangita	Evaluation (Mosaic for X); Analysis/WSM
Limperos, Kevin	Screening; Criteria Definition; Evaluation (Mosaic for X, HotJava); Analysis/WSM; Analysis/AHP; Mgmt/Admin
Poston Day, Jan	Evaluation (Netscape, Webworks); Analysis/WSM
Prabhala, Padmaja	Evaluation (Netscape); Analysis/WSM
Schmidt, Ginny	Screening; Criteria Definition; Analysis/WSM

2.4 Analysis

The analysis of the evaluation data was done using two techniques, a commonly used weighted scoring method (WSM) and a technique called Analytic Hierarchy Process (AHP). This was done on purpose as an experiment to see whether the choice of the “scoring” technique influences the result.

As can be seen in the results presented in chapter 5, there were relatively big differences between the two methods. However, the best tool was the same in the two techniques: Netscape.

Given that the use of same data and same evaluators resulted in quite different overall results, this leads us to conclude that the analysis or scoring technique may have a strong impact on the evaluation results. We have discussed the meaning and importance of these results in more detail in a separate report (Kontio, 1995), but we believe that the AHP results are more likely be more reliable, due to several fundamental limitations that the weighted scoring approach has.

2.5 Total Effort

The total effort spent on different activities was as follows:

Table 2-2: Effort by activities

Activity	Effort (hrs)		%
Search		20	14%
Screening		8	6%
Evaluation		79	55%
Criteria definition	40		28%
Mosaic for X	10		7%
Netscape	9		6%
Webworks	9.5		7%
HotJava	10.5		7%
Analysis/WSM		5	3%
Analysis/AHP		7	5%
Management/administration (planning meeti		20	14%
Learning about the methods and techniques		1	1%
other (vendor contacts, installations)		4	3%
Total		**144**	

3. Evaluation Criteria

The evaluation criteria was defined in detail before the evaluation started. The criteria was defined hierarchically in a top-down fashion based on the requirements defined or implied for the browser. The criteria definition also refined many of the initially general requirements.

The evaluation criteria was decomposed until a measurable, testable or observable characteristic was defined. These are called *tests* in the remainder of this document. Each test was defined in detail to provide a basis for consistent evaluations. The evaluation criteria and their definitions are listed in appendix B.

4. Evaluation Data

This section contains the evaluation data in "raw" format. In the following pages the "tests" used to evaluate the tools are listed as rows in the table and each of the alternatives is represented in columns two to five. Each cell describes how the tool in that column meets the test on that row.

Table 4-1: Evaluation Data

Criteria/Test	**Mosaic for X** ver 2.4	**Netscape** ver 1.1b3	**Webworks for Mosaic**, ver 1.5	**HotJava** ver 1.0a2
Test: Level 2 compatibility	no explicit statement	documentation confirms	no explicit statement	no explicit statement
Test: HTML Level 3 compatibility schedule	N/A	"will support HTML ver 3.0"	N/A	N/A
Test: Support for tables	supported in next version (2.6)	supports tables	conflicting evaluation info (supports/does not support)	not supported
Test: Display of mathematical equations and formulae	not supported	"not mentioned?"	not supported	can interprete and display math equations to some extent
Test: Other HTML Level 3 features currently supported	N/A	more sophisticated page presentation (multiple text columns, flexible image placement) additional security features third party applications (3D viewer, rich document viewer)	N/A	N/A
Test: Local save and print tests	save supports source, postscript and text printing for file or printer	save supports source, postscript and text printing for file or printer	save supports source, postscript, text and "formatted text" printing for file or printer	save not supported postscript printing supported
Test: Local tool activation	Supported via MIME mechanism (FTP, telnet, external viewers and e-mail)	Can activate external viewers (FTP, email, telnet, rlogin)	supported	Supported via. Java applets
Test: Automatic uncompress	supported	supported	supported	not supported
Test: Hotlist features	comprehensive support (Add current, Goto, Remove, Edit file, Dismiss, etc)	comprehensive support (Add current, Goto, Remove, Edit file, Dismiss, etc)	comprehensive support (Add current, Goto, Remove, Edit file, Dismiss, etc)	limited support, only add, delete, visit
Test: Interrupt of retrieval	supported	supported	supported	not supported, but multi-threading alleviates this somewhat
Test: Connection status management	supported	supported	supported	supported
Test: Download information display	supported	supported, with %	supported, with "z of x kB"	supported, with %, but confusing w/multiple items

Criteria/Test	Mosaic for X ver 2.4	Netscape ver 1.1b3	Webworks for Mosaic, ver 1.5	HotJava ver 1.0a2
Test: Page property management	not supported	not supported	not supported	not supported
Test: Incremental image loading	not supported	supported	not supported	supported
Test: Local caching of pages	supported	supported, cahching size can be adjusted	supported	supported
Test: Dynamic page updating	not supported	supported	not supported	supported if using Java scripts
Test: Customization of colors and fonts	supported for font types (not for size?) colors would require X-resource modifications	fonts customizable on all platforms (size and type) colors are customizable on Macintosh and MS-Windows	supported for font types (not for size) no color customization	not supported (only through X-resources)
Test: Multiple sessions	multiple windows possible	multiple sessions possible	supported via "New" and "Clone" windows	supported, multi-threaded no clone window available
Test: Integration capabilities	Supported. works with NCSA Collage, DTM, netCDF/HDF, and can be used as a HELP interface via signals	none ?	Yes, via its API	Unlimited w/Java language
Test: API	not supported	supported, platform specific APIs available	supported	supported via Java classes
Test: Related Support Language	not supported	not supported	not supported	Java
Test: On line help	available, also for HTML	available, also for HTML	supported	supported
Test: Product support	NCSA provides e-mail Q&A support	90-day product support and warrantee with purchase	email, hotline (conflicting info)	email
Test: Security features	Standard WWW authentication	uses patented RSA public key cryptographc technology	not documented	support several security modes: "No access", "Applet host", "Firewall", "Unrestricted"
Test: Bug list length and significance	List is short. New versions are released regularly to provide enhancements and fix bugs.	Bug lists reported with every release of beta and official versions of Netscape.	No bug list information was available in the on-line documentation.	Fairly lengthy, but not unusual for an alpha release
Test: references from other users	N/A	N/A	N/A	N/A
Test: User perceived quality of the documentation	“good”	“very good”	“good” (w/many acronyms)	“good”
Test: Perceived ease to learn	“easy”	“easy”	“easy”	“easy”
Test: Availability of examples	“good”	“good”	“good”	“good”
Test: Availability of on-line tutorial	conflicting evaluation data	available	conflicting data (“no” / “a tutorial of sorts is provided”	not available
Test: Usage problem list	none	locks the color table	search engine did not work, crashes how to restore fonts	several minor anomalies encountered
Test: Response time tests	instantenous local file open	instantenous local file open	instantenous local file open	instantenous local file open

Criteria/Test	Mosaic for X ver 2.4	Netscape ver 1.1b3	Webworks for Mosaic, ver 1.5	HotJava ver 1.0a2
Test: Initial CPU memory used	1469 Kb	1196 Kb	1282 Kb	2225 Kb
Test: Required disk space	3.4 Mb	2.6 Mb	2.8 Mb	0.345 Mb
Test: Mandatory platforms (Unix)	OK	OK	OK	OK
Test: Additional platforms (PC, Mac)	OK	OK	partial	no
Test: Ease of installation	easy	easy	easy	N/A
Test: Installation problem list	none	none	none	none
Test: Purchase price	Mosaic lisences through another company (O'Reilly) 1-199 users: $2995/user 200-500: $1648/user 500-999: $8/user/yr 1000-4999: $6.50/user/yr	1-9 users: $39/user/yr 10-249: $33/user /yr 250-499: $27/user /yr 500-4999: $23/user /yr	1st 100: $169/user next 100: $129/user next 300: $116/user next 500: $91/user	free for noncommercial use
Test: Distribution Costs	not applicable	not applicable	not applicable	not applicable
Test: Distribution Conditions				free distribution if source code not modified and not used for commercial purposes.
Test: Popularity of the tool	17%	70%	<1%	<1%

5. Analysis of Evaluation Data

The analysis of the evaluation data was using two approaches. Each method is described very briefly in the following two chapters and the results of the two methods are also presented. Details of the definition of the methods can be found in a separate report [Kontio 1995a].

5.1 Weighted Scoring Method

The weighted scoring method (WSM) has been used in most previous tool selection cases. It is based on the following steps:

1. Define criteria
2. Assign weight classes to each criterion, usually from 1-5, 5 meaning important and 1 not important.
3. Give scores to alternatives on each criterion, usually with a range of 1-5.
4. Multiply the weight and score on each tool and criterion and sum the total by tools.
5. The ranking of alternatives can be seen by the scores that each tool receives.

The weighted scoring method is easy and inexpensive to use. It also appears to be intuitive. However, it has several fundamental shortcomings, such as difficulty of assigning very low or high weights, difficulties in balancing a large number of criteria or alternatives, difficulties in defining the scores properly and sensitivity to the number and coverage of the criterion items.

Although ratio scale numbers are used in scoring, usually the scores given to alternatives are only of ordinal scale. Therefore, the totals can only be interpreted as giving ordinal rankings of alternatives, a fact that is often ignored when results are presented.

The results of the weighted scoring method are presented in table 4.1. Note that the absolute values of the scores in the table are misleading, they only imply order of the alternatives. They cannot be used to draw any conclusions how much better one alternative is from other one. They do not even necessarily give much support in terms of confidence in the ordering of the alternatives. However, the reverse of this is, of course, true: close values in scores indicate that ordering of alternatives may well fall within the margin of error in estimates.

The ranking of the alternatives is as follows, in decreasing order:

1. Netscape
2. Mosaic for X / Webworks for Mosaic
3. HotJava

Since the scores of Mosaic for X and Webworks for Mosaic were within one percent of each other, we could not indicate any preference over them.

Table 5-1: Weighted scoring method results

Criteria/tests	weight score	weight %	Mosaic	Netscape	Webworks	HotJava
Test: Level 2 compatibility	**5**	3.4%	3	3	3	3
Test: HTML Level 3 compatibility schedule	**5**	3.4%	0	3	0	0
Test: Support for tables	**5**	3.4%	0	5	0	0
Test: Display of mathematical equations and formulae	**3**	2.1%	0	0		2
Test: Other HTML Level 3 features currently supported	**3**	2.1%		3		
Test: Local save and print tests	**5**	3.4%	5	5	5	2
Test: Local tool activation	**5**	3.4%	5	5	5	5
Test: Automatic uncompress	**2**	1.4%	5	5	5	0
Test: Hotlist features	**5**	3.4%	5	5	5	2
Test: Interrupt of retrieval	**5**	3.4%	5	5	5	0
Test: Connection status management	**5**	3.4%	4	5	4	3
Test: Download information display	**3**	2.1%	4	5	4	3
Test: Page property management	**1**	0.7%	0	0	0	0
Test: Incremental image loading	**3**	2.1%	0	5	0	5
Test: Local caching of pages	**4**	2.8%	4	5	4	4
Test: Dynamic page updating	**3**	2.1%	0	5	0	5
Test: Customization of colors and fonts	**4**	2.8%	4	3	4	1
Test: Multiple sessions	**3**	2.1%	4	5	3	4
Test: Integration capabilities	**5**	3.4%	3		5	5
Test: API	**5**	3.4%	0	5	5	5
Test: Related Support Language	**5**	3.4%	0	0	0	5
Test: On line help	**4**	2.8%	4	4	5	4
Test: Product support	**5**	3.4%	4	4	5	4
Test: Security features	**4**	2.8%	1	5	1	5
Test: Bug list length and significance	**3**	2.1%	4	3		1
Test: User perceived quality of the documentation	**4**	2.8%	4	5	3	4
Test: Perceived ease to learn	**5**	3.4%	5	5	5	5
Test: Availability of examples	**4**	2.8%	5	5	5	5
Test: Availability of on-line tutorial	**3**	2.1%	5	5	5	0
Test: Usage problem list	**3**	2.1%	5	4	2	3
Test: Response time tests	**3**	2.1%	5	5	5	5
Test: Initial CPU memory used	**3**	2.1%	4	3	3	2
Test: Required disk space	**2**	1.4%	1	2	2	5
Test: Mandatory platforms (Unix)	**5**	3.4%	5	5	5	2
Test: Additional platforms (PC, Mac)	**3**	2.1%	5	5	3	0
Test: Ease of installation	**3**	2.1%	5	5	5	5
Test: Installation problem list	**3**	2.1%	5	5	5	5
Test: Popularity of the tool	**4**	2.8%	3	5	0	0
Total of weight scores	145	100%				
Score			**470.0**	**591.0**	**467.0**	**427.0**

We also used the information in table 4-1 to calculate other metrics that would characterize the alternatives, although none of them turned out to be conclusive. These are presented in table 4-2. The rationale of this effort was to find out whether one of the alternatives would have been pareto optimal to the others, i.e., being equal or superior on all criteria. This was not the case, but the information in table 4-2 still gives some indication of the sensitivity of alternatives.

The row "Number of times better than others" indicates how many times the alternative was the best over the criteria. The second line, "Number times one shared the best score", indicates how many times the alternative had to share the win, i.e., it had an equal value with other winning alternatives on a criterion. The "Number times one shared the best score" row is the total of the above, indicating how many times the alternative was either the best or one of the best. The row "did not win" simple shows how many times the alternative lost to one or more alternatives. The row marked with "sum of weights where lost to others" calculates the percentage total of weights where the alternative was worse than one or more other alternatives. Finally, the last row indicates the number of times the alternative lost to others when the criterion was considered important, i.e., having values 4 or 5.

The figures in table 4-2 are inconclusive. They cannot be used to draw any strong conclusions about the result. However, they give an indication of the confidence that can be placed on the weighted scoring results. For instance, even though Netscape had the best score, there were still 10 criteria where it lost, and the weight of these criteria had a total of 26%. Some of these criteria were ranked relatively important (integration capabilities, related support language, product support, on-line help and customization of colors and fonts). Especially considering that the weighting method used prevented the allocation of more than 3.4% weight on any single criterion, this raises the level of uncertainty about the results.

After reviewing the criteria in question, we intuitively believe that the "weight cap" of the weighted scoring method had a strong influence in the results. In particular, the difference between Mosaic and Webworks in this respect may justify further analysis.

Table 5-2: Further analysis of the weighted scoring method results

	Mosaic	Netscape	Webworks	HotJava
Number of times better than others	3	9	2	3
Number times one shared the best score	16	19	17	13
Number times won or a tie	19	28	19	16
Did not win	19	10	19	22
sum of weights where lost to others	52%	26%	47%	59%
Number of times lost when the criteria was weighted 4 or 5	12	5	8	13

5.2 Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) technique was developed by Thomas Saaty for multiple criteria decision making situations. The technique has been widely and successfully used in several fields. The AHP is based on the idea of decomposing a multiple criteria decision making problem into a hierarchical set of criteria that characterize the problem. At each level in the hierarchy the relative importance of factors is assessed by pair-wise comparisons. Finally, the alternatives are compared in pairs with respect to the criteria. This results in a systematic comparison approach that yields ratio scale preferences between alternatives. The AHP method also has a supporting tool that allows various kinds of analyses to be made, e.g., experimenting with the sensitivity of the results.

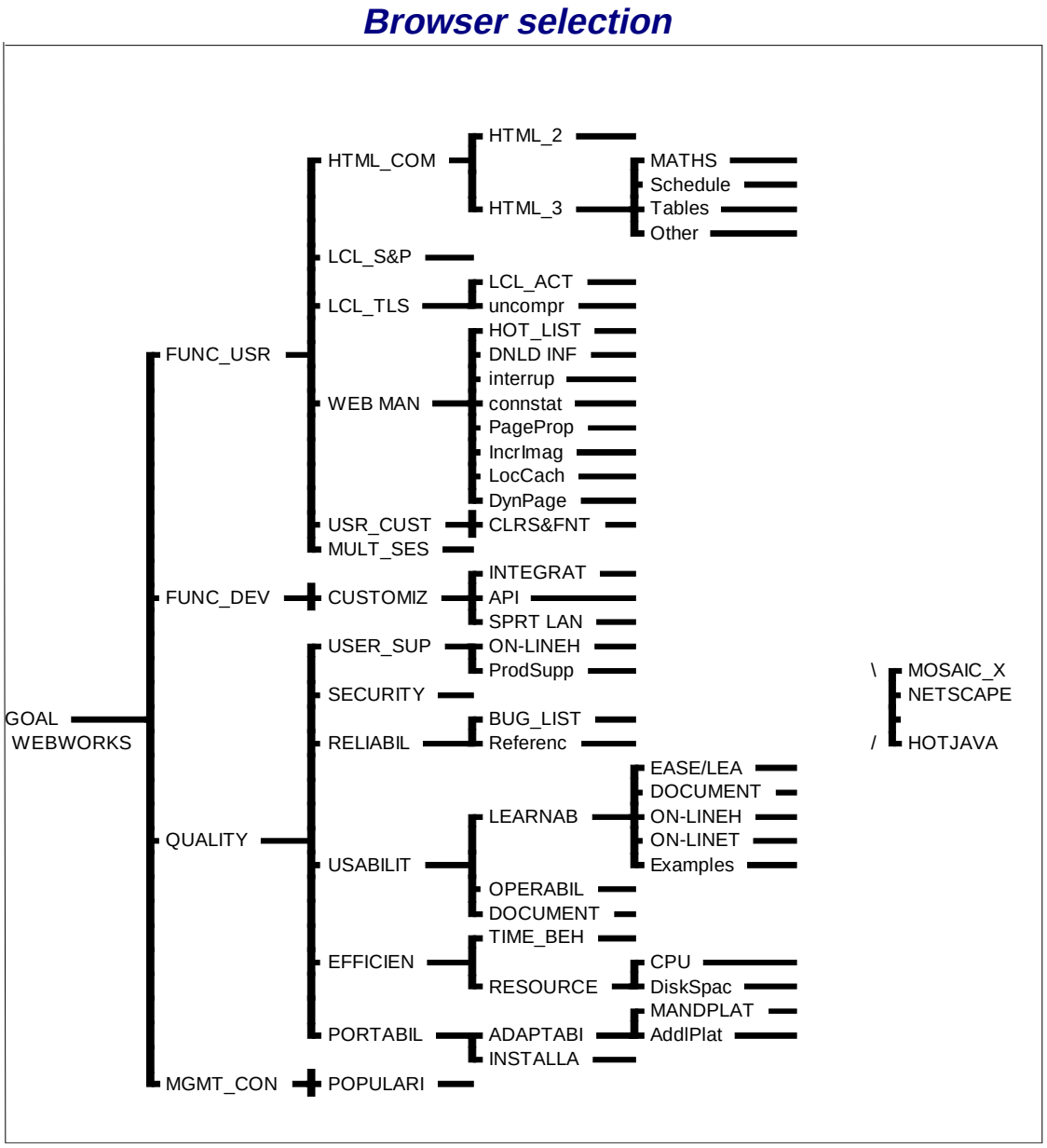
The following are the main steps in applying AHP:

1. Define a hierarchy of factors that influence the decision, resulting in a hierarchical structure of factors that have alternatives as the leaf nodes in the hierarchy
2. Define the importance of factors on each level by pair-wise comparisons
3. Define the preferences of alternatives by pair-wise comparisons
4. Check the consistency of rankings and revise the rankings if they are too inconsistent
5. Present the results of the evaluation, the alternative with the highest priority being the one that is recommended as the best alternative.

The benefits of the AHP method include automatic support for checking consistency of preferences, ability to yield ratio scale rankings between alternatives, ability to make sensitivity analyses, and solid theoretical foundations for the principles used. The disadvantages of AHP are that it appears more complex, requiring more explanation and training and that it is more expensive: use of a tool (Expert Choice) is a practical necessity and the use of the tool adds one to two hours of effort to the whole evaluation (note that these costs were within 2-5% of the total cost of the evaluation in our case).

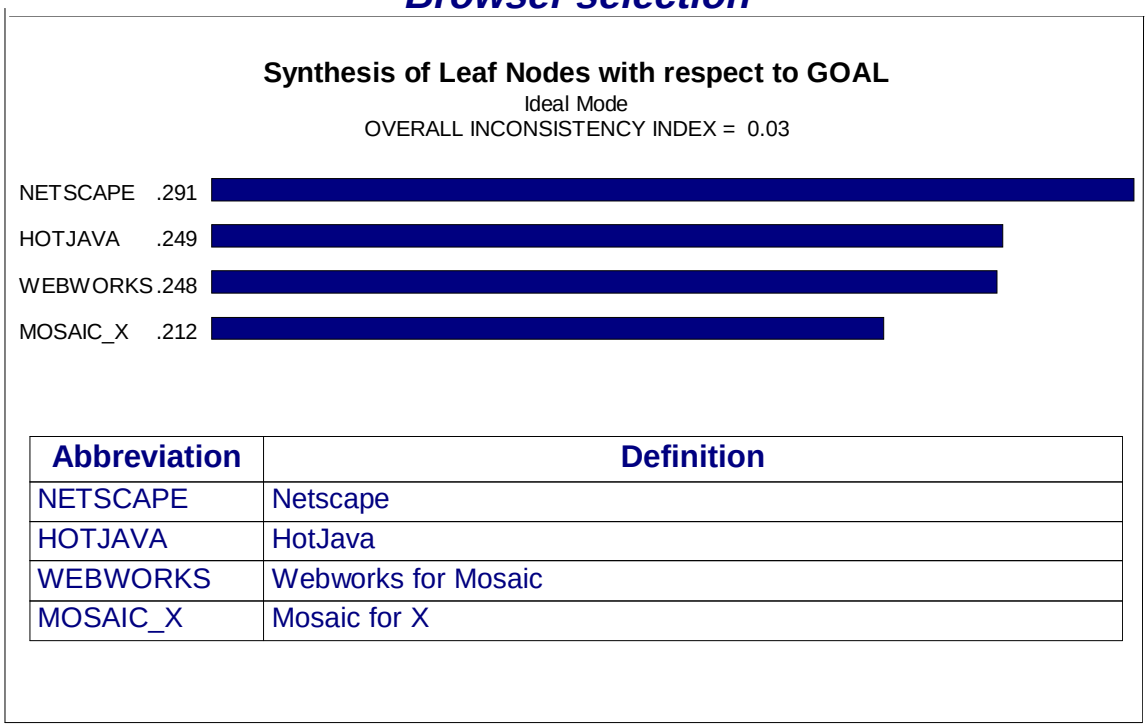
We have presented the hierarchy of criteria in Figure 5-1. The four alternatives are presented only once in the figure, although they belong as leaves to all end nodes in the criteria tree. The hierarchy in Figure 5-1 is the same as in the criteria definition document [Kontio 1995b], except for some items that were dropped during the analysis phase.

Figure 5-1: Hierarchy of evaluation criteria used in the AHP method



We have presented the results of the AHP ranking method in Figure 5-2. An important aspect of the results in Figure 5-2 is that the values for each alternative are actually expressed as numbers on a ratio scale. The relative sizes of the bars in Figure 5-2 reflect the relative superiority of the alternatives to each other.

Figure 5-2: Results of the AHP method

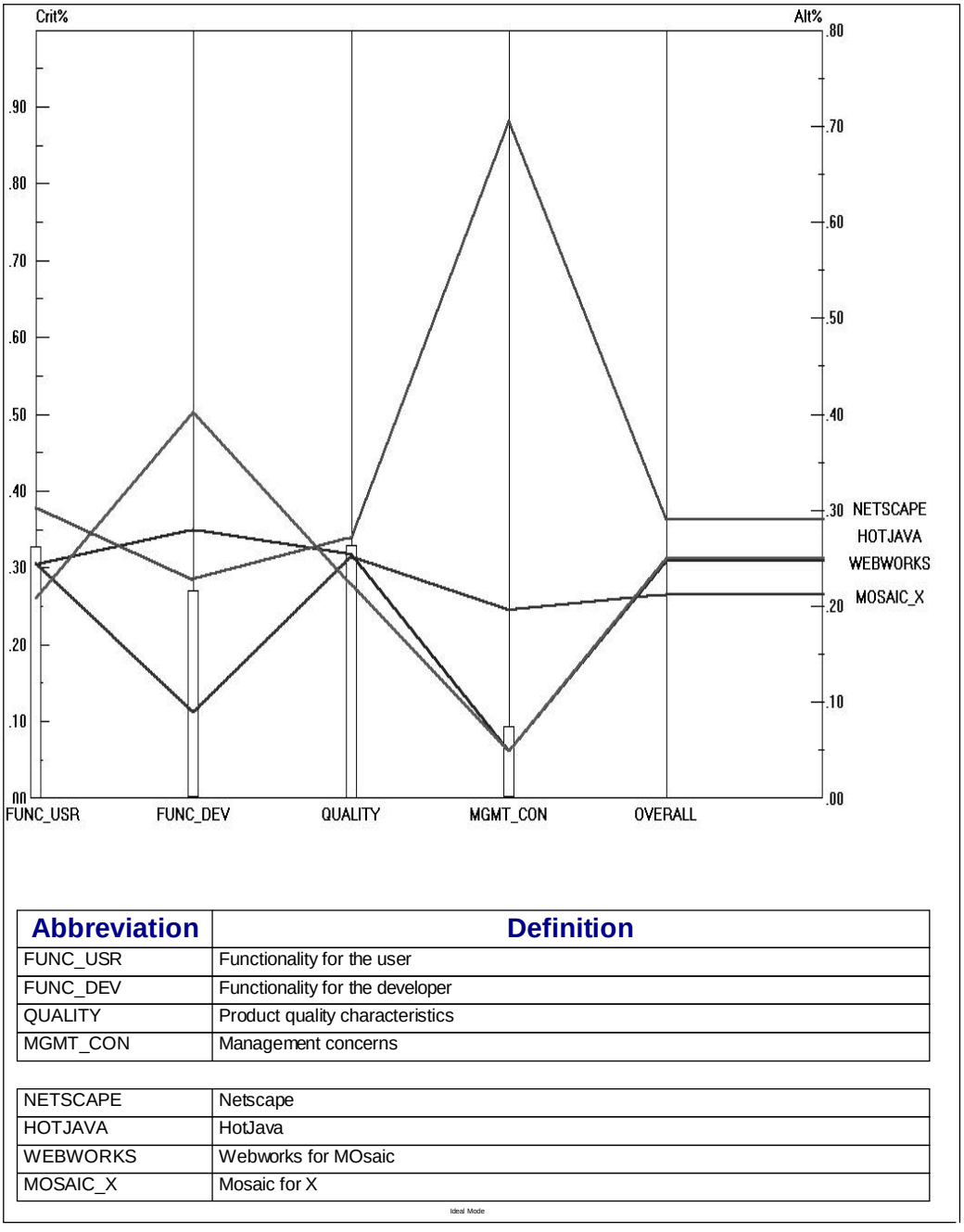


Abbreviation	Definition
NETSCAPE	Netscape
HOTJAVA	HotJava
WEBWORKS	Webworks for Mosaic
MOSAIC_X	Mosaic for X

The Expert Choice tool also supports various kinds of sensitivity analyses on the preferences entered. We have included one example of them in Figure 5-3. It shows a profile of each tools performance by the four main criteria groups. The overall rankings for the alternatives can be read on the vertical line starting from *x* axis label "overall". The rankings by each main criteria group for each alternative can be read from the vertical, "zagged" lines. The weight of each main criteria group is presented as vertical bars starting from the *x* axis where the criteria group is named. The weights of criteria groups can be changed and the impact of these changes to the overall score can be displayed graphically immediately.

As the Figure 5-3 shows, Netscape is particularly strong in the area of management concerns, i.e., popularity of the tool. It is inferior to other two tools only in the area of functionality to the developer. If these criteria were to be rated more important, HotJava might be an alternative to consider. Although Webworks also is better than Netscape in functionality to the developer, it is worse than HotJava in this respect and just about the same as HotJava in all other respects.

Figure 5-3: Example of a graph displaying the sensitivity of preferences



Abbreviation	Definition
FUNC_USR	Functionality for the user
FUNC_DEV	Functionality for the developer
QUALITY	Product quality characteristics
MGMT_CON	Management concerns

NETSCAPE	Netscape
HOTJAVA	HotJava
WEBWORKS	Webworks for MOsaic
MOSAIC_X	Mosaic for X

6. Conclusions

For the purposes of the selection task, Netscape can be considered the best choice for the project. It appeared as the “winner” in both analysis methods. Furthermore, its relative distance to others in the AHP method suggests that it is better by a non-trivial margin.

It is more difficult to assess what is the second best alternative as the two analysis methods yielded different results. However, as the foundations of the AHP method are better justified and it provides more facilities for analyzing the sensitivities of alternatives, we are relying more on the results of the AHP method. From this perspective, the second alternative to consider is HotJava. During evaluation it was pointed out that within a year it is likely that the criteria under functionality to the developer are likely increase in importance. As this is a strong area for HotJava, this indicates that its ranking to other alternatives is not likely to get worse.

The results of the comparison of the two analysis methods also worth pointing out, although they are not directly related to the selection of the browser. As we have discussed in a separate technical report (Kontio, 1995), there are strong reasons to avoid the weighted scoring method. However, it can be used in situations where the number of criteria and alternatives are small and exceptional care is taken to overcome the limitations of the approach.

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Appendix A: Abbreviations and Acronyms

AHP Analytic hierarchy process

COTS Commercial, off-the-shelf (software)

ECS EOSDIS Core System

HTML Hypertext mark-up language

OTSO The name of the off-the-shelf software selection method used in this paper

UMCP University of Maryland at College Park

WSM Weighted scoring method

Appendix B: Evaluation Criteria Definitions

Definition Template

The criteria definition framework consists of a hierarchy, or a tree, of terms that are broken down to well-defined observations or tests at the leaf level. These leaf level items are identified by the word "Test" in the heading, although the value for the "test" is not always obtained through conducting a real test.

Each test will be defined using the following template:

Heading Heading for each Test is marked with the word "Test" in the beginning of it. The text after the word "Test" contains a unique identifier for the criterion.

Definition A definition of the test.

Rationale Description of the rationale for the test and how it relates to the evaluation criteria.

Scale The scale or type of description used for documenting the result of the test:

Free format description the result of the test consists of a free format description of how the alternative satisfies the criterion.

List A list of features, characteristics, functions etc. is produced.

Structured description there is a template or a checklist that defines what should be described for each alternative.

Nominal Classes are identified but they are not ordered.

Ordinal Classes are identified and they are ordered.

Interval The scale has meaningful interpretation of distance between entities, but their ratios cannot be calculated, i.e., "there is no meaningful zero point".

Ratio Entities can have ratios, "zero is a meaningful concept".

Absolute The number of entities is counted.

Unit/classes Definition of the unit of measure or the classes used, which ever is applicable.

Screening rule Definition of a possible level that is required for an alternative to be selected for detailed evaluation. This field is used for documenting which criteria were used in the screening phase.

Baseline Baseline is the minimum required level of functionality and features that the application must satisfy when it is delivered [Kontio 1995]. In this situation, the baseline is the same as the screening criteria.

Qualitative description Guidelines how additional information about the test should be documented.

Source How the value for the test can be determined for each alternative.

Test priority Description of how important it is to find out the value for a particular test. Note that this is not the same as the importance or weight of the test or criteria in decision making, although these terms are closely related. The prioritization here takes account the estimated cost of obtaining the information, i.e., if a test is very expensive, it may be given a low test priority even if it is one of the most important factors in decision making. The test priority classes are as follows:

Required The value for the test is essential for the evaluation and must be obtained.

Recommended It is recommended that the value for the test is obtained, if time available for the evaluation allows it.

Optional The result of the test could be useful in the evaluation. The value should be obtained only if all other criteria have been covered and there is time available.

Evaluation Criteria

The following sections describe the evaluation criteria. The criteria is divided into three main classes: functional requirements, quality characteristics and management concerns. The technical evaluation primarily deals with the first two.

Functional Requirements (user)

Functional requirements are specific, identifiable functional features that are expected in the application. The purpose of the evaluation is to see how much of the functionality can be provided by each reusable tool candidate.

HTML Compatibility

How well the tools keep up with new versions of HTML.

Test: Level 2 compatibility

Definition	Degree to which the HTML level 2 specifications and features are supported by the tool.
Rationale	Level 2 is the required standard.
Scale	ordinal
Classes	full compliance not level 2 compliant
Screening rule	yes
Baseline	Level 2 specification.
Qualitative desc.	If HTML level 2 specifications are not fully met, there should be a list of the missing features.
Source	Vendor statement or HTML level 2 specification and tool features.
Test priority	**Required**

HTML Level 3 Compliance

This criteria and the tests measure how well the tool supports some more advance features of the HTML.

Test: HTML Level 3 compatibility schedule

Definition	When the tool is scheduled to be HTML level 3 compliant.
Rationale	HTML level 3 compliance will eventually be required. The speed of reaching that level indicates the vendor's ability keep up with the development.
Scale	interval
Unit	date
Screening rule	No
Baseline	NA
Qualitative desc.	Statement on how reliable the vendor's release date is, e.g., have the previous release dates been reliable.
Source	Vendor statement.
Test priority	Recommended

Test: Support for tables

Definition	Does the tool support displaying information in table format.
Rationale	Table format will be used in EOS HTML pages.
Scale	ordinal
Classes	tables supported, tables not supported
Screening rule	No
Baseline	NA
Qualitative desc.	List of supported features.
Source	HTML level 3 specification, tool.
Test priority	Recommended

Test: Display of mathematical equations and formulae

Definition	Does the tool support the display of mathematical equations and formulae.

Rationale	Mathematical information will need to be displayed in the EOS system.
Scale	list
Classes	mathematical equations supported, mathematical equations not supported
Screening rule	No
Baseline	NA
Qualitative desc.	List of supported features.
Source	HTML level 3 specification, tool.
Test priority	**Required**

Test: Other HTML Level 3 features currently supported

Definition	List of HTML level 3 features that the current version of the tool already supports.
Rationale	Supported HTML level 3 features can be used immediately. This also reflects how soon the remaining level 3 features will be supported.
Scale	list
Screening rule	No
Baseline	NA
Qualitative desc.	List of supported features. The following items should be checked specifically (see "http://gdbdoc.gdb.org/letovsky/genera/genfuture.html" for details): Array Widgets: scrollable, editable spreadsheet widgets for display and editing of tabular data. Widget/Document Attributes: settable attribute-lists for widgets (to store old values, hidden id#, etc.) and documents. Field Events: to support immediate validation of name-valued fields and subbing (moving from one form to other and transferring results between forms during query construction or data editing) the finer-granularity client-server communication events is needed. Field Events are client=>server messages triggered by completion of text field input, toggling of a select field, or pushing a button field. Immediate Commands: these are server=>client messages which the client interprets as commands to do something instead of an HTML document to display. The commands include: 4.1 Store a value in a widget/document attribute. 4.2 Access a widget/document attribute. 4.3 Inhibit document stack push. 4.4 Pop document stack. 4.5 Dialog boxes. 4.6 Sequences of actions. Split Forms: independent windows on same page. Programmable Menus: form documents should be able to include menus for themselves.
Source	HTML level 3 specification, tool.
Test priority	Recommended

Local save and print

Test: Local save and print tests

Definition	Does the tool support saving and printing of HTML pages and information contained in them.
Rationale	WWW page information will need to be stored frequently.
Scale	list
Possible values	printing to a specified printer (postscript, HTML, plain text without HTML control characters) saving in HTML format saving the page data without HTML characters saving in some wordprocessor format
Screening rule	No
Baseline	NA
Qualitative desc.	Short notes on how each saving or printing option works.
Source	Tests done with the tools.
Test priority	**Required**

Activation of local tools

Test: Local tool activation

Definition	Does the tool support the activation of external local tools upon receiving data from WWW.
Rationale	A common way of downloading and browsing WWW data.
Scale	Free format description
Screening rule	Yes
Baseline	NA
Qualitative desc.	Description of any problems or restrictions in tool activation.
Source	Tests done with the tools.
Test priority	**Required**

Test: Automatic uncompress

Definition	Does the tool support automatic uncompressing of files before submitting data to a local browser.
Rationale	A potentially useful feature.
Scale	Ordinal
Screening rule	No
Baseline	NA
Qualitative desc.	Description of how the uncompression feature could be implemented.
Source	Tool specifications.
Test priority	Recommended

Web maneuvering

Test: Hotlist features

Definition	Does the tool support a hot list and what are its features.

Rationale	A frequent utility for users.
Scale	List
Possible values	add, delete, goto, ...
Screening rule	no
Baseline	NA
Qualitative desc.	Description of how each feature works, if not obvious.
Source	Tests done with the tools.
Test priority	**Required**

Test: Interrupt of retrieval

Definition	Does the tool support interrupting of retrievals and how the interrupts are controlled.
Rationale	Retrievals may need to be canceled occasionally.
Scale	Free format description
Possible values	no interrupt support interrupt all retrievals selective interrupt of retrievals
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Tests done with the tools.
Test priority	Recommended

Test: Connection status management

Definition	Does the tool support the display of connection status information.
Rationale	May be needed for managing retrievals.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	Describe the features in connection management.
Source	Tests done with the tools.
Test priority	Recommended

Test: Download information display

Definition	Does the tool display the downloading progress.
Rationale	Feature that allows users to monitor progress of downloads.
Scale	Free format description
Possible values	not supported bytes retrieved percent complete
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Tests done with the tools.
Test priority	**Required**

Test: Page property management

Definition	Does the tool support the storing of page parameters within and/or between sessions.
Rationale	A nice to have feature.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Tests done with the tools.
Test priority	Optional

Test: Incremental image loading

Definition	Does the tool support incremental image loading, i.e., loading and displaying images as they are retrieved rather than waiting until the whole image is retrieved before displaying it.
Rationale	Needed for user comfort.
Scale	nominal class
Possible values	supported, not supported
Screening rule	no
Baseline	NA
Qualitative desc.	Description of how incremental image loading works, if not obvious.
Source	Tests done with the tools.
Test priority	Recommended

Test: Local caching of pages

Definition	Does the tool support local caching of pages.
Rationale	May improve the performance when retrieving frequently visited pages.
Scale	nominal classes
Possible values	supported, not supported
Screening rule	no
Baseline	NA
Qualitative desc.	Description of the caching options: set the sizes of memory and disk caches and the frequency to check documents in cache (e.g., every time, once per session, never)
Source	Tests done with the tools.
Test priority	Recommended

Test: Dynamic page updating

Definition	Does the tool support dynamic page updating, i.e., the .possibility to either schedule retrievals from the client or to receive updates from the server.
Rationale	Some on-line data may need to use this feature.
Scale	nominal classes
Possible values	supported, not supported
Screening rule	no

Baseline	NA
Qualitative desc.	Description of the features available in this page updating.
Source	Tests done with the tools.
Test priority	Recommended

User customization options

Test: Customization of colors and fonts

Definition	Does the tool support the customization of colors and fonts and can they be stored as profiles.
Rationale	May be a convenience feature.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	Describe what aspects can be customized (fonts, colors), to what they can be associated to (HTML items, document attributes) and how these can be stored (are style schemes possible ?).
Source	Tests done with the tools.
Test priority	**Required**

Multiple sessions

Test: Multiple sessions

Definition	Does the tool support multiple sessions, i.e., can more than one active window be opened to access more than one WWW page simultaneously ?
Rationale	May be a desired feature.
Scale	nominal class
Possible values	supported, not supported
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Tests done with the tools.
Test priority	Recommended

Functional Requirements (development)

Functional requirements are specific, identifiable functional features that are expected in the application. The purpose of the evaluation is to see how much of the functionality can be provided by each reusable tool candidate.

Customization

Test: Integration capabilities

Definition	What are the integration capabilities offered by the tool, is there a "developer kit" available (or when it will be available) and what does it allow to do ?
Rationale	
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Tests done with the tools.
Test priority	**Required**

Test: API

Definition	Does the tool allow third party applications to remotely control or interface to it.
Rationale	Can allow the integration with other applications.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	The type API and its limitations should be described.
Source	Tests done with the tools.
Test priority	**Required**

Test: Related Support Language

Definition	Does the tool have an associated programming language for generating code that interacts with the HTML (an example is the Hotjava product from Sun, which has an associated language to support amazing types of graphical/multi-media interactions).
Rationale	This feature would ease the integration of the tool and support the development of graphical interfaces.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	The type of support language and its features described.
Source	Tests done with the tools.
Test priority	**Required**

Quality Characteristics

User support

Test: On line help

Definition	What is the on-line help support available in the tool.
Rationale	Frequently used support feature.

Scale	Free format description
Screening rule	no
Baseline	NA
Description	The description should address at least the following characteristics: • is an on-line help available • is the on-line help context sensitive • does the on-line help provide adequate support or does it usually require reading of manuals • how good is the search facility and index of the on-line help • does on-line help support hypertext-like browsing of information
Source	Tests done with the tools.
Test priority	**Required**

Test: Product support

Definition	What kind of product support is available.
Rationale	May be required by some users.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	Is there a hot lines, what are the terms of maintenance agreement..
Source	Tests done with the tools.
Test priority	Recommended

Security

Test: Security features

Definition	What are the security features supported.
Rationale	Security access may need to be controlled by some applications.
Scale	List
Possible values	
Screening rule	no
Baseline	NA
Qualitative desc.	User authentication.
Source	Tests done with the tools.
Test priority	**Required**

Reliability

Defect rate during evaluation

Test: Bug list length and significance

Definition	Evaluation of the bug list issued by the vendor: how frequently bug lists are issued, how significant bugs are reported in it and how quickly bugs are corrected.

Rationale	Bug list reflects the attention given to bugs and the rate of correcting them. However, this is a very subjective test as, e.g., the lack of a bug list may not be a sign of reliable software. Ideally, several bug lists over time should be analyzed to see how bugs accumulate to and are removed from the list.
Scale	free format description
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description of the bug list evolution.
Source	Evaluation of bug lists.
Test priority	**Required**

Test: references from other users

Definition	Summary of references from other users.
Rationale	Statements from other users represent their usage experiences. They may address reliability directly or indirectly.
Scale	list
Unit	N/A
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Relative estimates of the reliability.
Source	Contacts to other users.
Test priority	Recommended

Usability

Usability refers to the ease of use of the tool by the users. This aspect will need to be elaborated further.

Documentation

Clarity of documentation

Test: User perceived quality of the documentation

Definition	Subjective rating of the ease to read and lack of ambiguity in the documentation given by a group of evaluators
Rationale	A clear and unambiguous documentation makes easy for the evaluators to incorporate the components into their code
Scale	Ordinal (poor, acceptable, good, excellent)
Unit	N/A
Screening rule	NO
Baseline	N/A
Qualitative desc.	Description
Source	One or more evaluation sessions with selected evaluators
Test priority	Recommended

Learnability

Test: Perceived ease to learn

Definition	Evaluators perception of the ease or difficulty to learn to use the system.
Rationale	Measures, although subjectively, a large set of factors that influence learnability.
Scale	Free format description.
Unit	N/A
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description
Source	evaluations
Test priority	**Required**

Clarity of documentation

Already defined.

Test: Availability of examples

Definition	Description and list of examples on the use of the tool.
Rationale	Examples can be used as training material and they provide a useful way to learn about the use of the tool.
Scale	List
Description	The description of the examples should address at least the following classes of characteristics: • are examples from real applications or "toy" applications only • are examples similar to this project's domain • are examples relevant to this project's software environment • number of examples • coverage of different situations in the examples
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description
Source	tool documentation
Test priority	Optional

Test: On-line help

Already defined

Test: Availability of on-line tutorial

Definition	Description of the available on-line tutorial.
Rationale	On-line tutorial is the most frequently used introduction to the tool.
Scale	List
Description	The description should address at least the following characteristics: • is an on-line tutorial available • what is the average duration of the whole tutorial

- does the tutorial include interactive practice sessions
- is there a possibility to backtrack

Unit	list
Screening rule	N/A
Baseline	none
Qualitative desc.	Description
Source	tool documentation
Test priority	**Required**

Operability

Perceived ease of use

Test: Usage problem list

Definition	List and description of the problems encountered during the use of the tool.
Rationale	Number of problems and their descriptions are likely to correspond to the number and type of problems to be encountered by potential users.
Scale	list
Unit	N/A
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description
Source	Records kept by the person evaluating the tool.
Test priority	**Required**

Efficiency (Performance)

Time behavior

Test: Response time tests

Definition	The time it takes to start the tool using a local HTML page.
Rationale	This is the only network independent performance measure. Network retrievals have much longer delays and the tool efficiency is likely to have only a very marginal impact during normal use.
Scale	ratio
Unit	seconds
Screening rule	NA
Baseline	NA
Qualitative desc.	NA
Source	Evaluation
Test priority	**Required**

Resource behavior

Memory usage

Test: Initial CPU memory used

Definition	Amount of CPU (virtual) memory required during execution.
Rationale	This has a direct impact on the system resource usage.
Scale	ratio
Unit	kB
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description
Source	Evaluation
Test priority	Recommended

Test: Required disk space

Definition	Amount of disk space required by a full user installation of the product.
Rationale	This has a direct impact on the system disk space usage.
Scale	ratio
Unit	kB
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description
Source	Evaluation
Test priority	Recommended

Portability

Adaptability

Test: Mandatory platforms

Definition	Does the tool run on Unix (including DEC Alpha, SGI, Sun, HP, IBM).
Rationale	required platforms for the project.
Scale	ordinal class
Possible values	runs on required platforms, does not run
Screening rule	Yes
Baseline	Available on Unix.
Qualitative desc.	
Source	Tests done with the tools.
Test priority	**Required**

Test: Additional platforms

Definition	Does the tool run on Mac and PC platforms.
Rationale	These platforms are assumed to be desirable, but not required by the user community.
Scale	ordinal class
Possible values	runs on additional platforms, does not run

Screening rule	no
Baseline	NA
Qualitative desc.	List the platforms the tool runs on.
Source	Tests done with the tools.
Test priority	Recommended

Installability

Test: Ease of installation

Definition	A subjective estimate of the ease to install the system.
Rationale	Installation of the system may be required by several users during the project life cycle.
Scale	ordinal
Classes	
easy	can be done in less than 10 minutes without having to answer any technical questions
normal	requires 10-30 minutes or requires the user to know some basic information about hardware/software configuration
difficult	requires more than 30 minutes or requires users to answer difficult technical questions
Screening rule	N/A
Baseline	N/A
Qualitative desc.	NA
Source	Records kept by the person installing the software.
Test priority	Recommended

Test: Installation problem list

Definition	List and description of the problems encountered during the installation of the tool.
Rationale	Seriousness of the installation problems can be assessed when these descriptions are available. Installation problems may indicate additional problems with the tool.
Scale	list
Unit	N/A
Screening rule	N/A
Baseline	N/A
Qualitative desc.	Description
Source	
Test priority	Recommended

Management Concerns

Cost

Acquisition costs

Test: Purchase price

Definition	Out of pocket costs for purchasing 50 licenses and maintaining up-to-date versions for the next 5 years.
Rationale	Direct measure of costs.
Scale	Ratio scale
Unit	U.S. dollars
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Vendor
Test priority	**Required**

Distribution costs and conditions

Test: Distribution Costs

Definition	Possible costs involved in distributing the tool within the ECS V1 System.
Rationale	Direct measure of distribution costs.
Scale	Ratio scale
Unit	U.S. dollars
Screening rule	no
Baseline	NA
Qualitative desc.	
Source	Vendor.
Test priority	**Required**

Test: Distribution Conditions

Definition	Possible conditions of distributing the tool within the ECS V1 User Community.
Rationale	Some vendors may restrict the distribution to specific user groups or type of distribution.
Scale	Free format description
Screening rule	no
Baseline	NA
Qualitative desc.	All relevant restrictions and/or conditions should be described.
Source	Vendor.
Test priority	**Required**

Strategic concerns

Test: Popularity of the tool

Definition	How popular is the tool currently.
Rationale	Current tool popularity reflects its competitive position and the probability of it being available in the future and being competitive.
Scale	absolute
Unit	Current number of users
Screening rule	no
Baseline	NA
Qualitative desc.	Any comments about the estimated growth in user base.
Source	Vendor, market information and Internet news.
Test priority	**Required**

Appendix C: Web Browser List

This appendix lists the browsers found in the search phase. The first column in the table in the following pages contains the name off the product, second and third columns list the World Wide Web addresses (URL) and FTP addresses for the tools, The last column includes comments on the main features or characteristics of the product.

Product Name	URL	Anonymous FTP	Note
X Window Browsers			
Arena	http://www.w3.org/hypertext/WWW/Arena/	ftp.w3.org:/pub/www/arena	By w3C. A testbed for HTML 3 documents. Prerelease, 0.96s supported. Not a general-purpose browser yet. Buggy.
Ariadne	http://web1.osf.org:8001/ri/announcements/Ariadne_Datasheet.html	riftp.osf.org:/pub/web/Ariadne	By OSF. Research prototype offers two extensions: a "back channel" and a graphical history tree. Other technologies released by OSF: DCE Web, WebMail, OreO, Group Server. Released on May 1, 1995. Avail on HP only at this time.
Chimera	http://www.unlv.edu/chimera/	ftp.cs.unlv.edu:/pub/chimera	Uses Athena not Motif. Source code is available.
CLRMosaic	http://www.clr.toronto.edu/CLRMOSAIC/help-about.html		Integrates interactive 3D model, mapping, and hypermodel support. Allows the handling of spatial databases along with traditional hypertext data sources. On SGI only.
Dancer	http://www.cs.indiana.edu/hyplan/smiale/dancer.html	ftp.cs.indiana.edu:/pub/smiale/dancer.tar.gz	A modularized WWW client written in Python. Requires python and tkinter.
Enhanced Mosaic	http://www.spyglass.com/mos_home.htm		through OEM channels (> 10K copies). Has an open architecture for modular security framework and a software development interface. MS Windows, Mac versions are avail.
HotJava	http://java.sun.com/	java.sun.com:/pub/hj-alpha2.tar.Z	"executable content". Brings interactivity to Web pages and showcases many of the capabilities of the Java language. Window95, NT, MacOS 7.5 versions are underway.
MidasWWW	http://www.w3.org/hypertext/WWW/MidasWWW/Status.html	info.cern.ch:/pub/www/src/midaswww-1.0.tar.Z	A beta by Tony Johnson.

Product Name	URL	Anonymous FTP	Note
Netscape	http://home.netscape.com/	ftp.netscape.com:/netscape/unix	By Netscape Communications Corp. Free for nonprofit and educational use. MS Windows and Mac versions also avail. 1.1N was officially released on April 25, 1995. On May 23, Netscape announced that they are licensing Sun Java technology.
Sesame (Virtual Places)	http://www.ubique.com/Products/sesame_software.html	ftp.ubique.com	managed by "Doors" servers. Enables real-time interaction between the information provider and the consumer, and among individuals with a common interest in the information.
SMosaic	http://www.commerce.net/software/SMosaic/	ftp.commerce.net, for authorized users only	encryption and authentication enhancements.
tkWWW	http://uu-gna.mit.edu:8001/tk-www/help/overview.html	info.cern.ch:/pub/www/dev	Beta. Requires tk and tcl. A browser and an editor.
ViolaWWW	http://berkeley.ora.com/proj/viola/violaHome.html	ftp.ora.com:/pub/www/viola	Two versions: Motif and Xlib. Beta, unsupported.
WebSpace	http://www.sgi.com/Products/WebFORCE/WebSpace/		By SGI and Template Graphics Software. A 3D viewer designed to work in concert with Web browsers such as Mosaic and Netscape. Support VRML (Virtual Reality Markup Language). Beta version was released free of charge on May 18, 1995.
WebWorks Mosaic (GWHIS)	http://www.quadralay.com/products/products.html		By Quadralay, based on NCSA Mosaic. Windows version is available and Mac version is expected. Other products include: Enterprise Server, Search System, Document Translator, Mosaic Software Developers Kit.
WWWinda	http://info.gte.com/ftp/circus/papers/www94/wwwinda.html		An Orchestration Service for WWW browsers and accessories.
XMosaic	http://www.ncsa.uiuc.edu/SDG/Software/XMosaic/	ftp.ncsa.uiuc.edu:/Mosaic/Unix	By NCSA. Source code is avail. MS Windows and Mac versions also avail. 2.6b2 was released on May 19, 1995.

Product Name	URL	Anonymous FTP	Note
Text-mode Browsers			
Emacs w3 mode	http://www.cs.indiana.edu/elisp/w3/docs.html	ftp.cs.indiana.edu:/pub/elisp/w3	Runs under X, NeXTStep, VMS, OS/2, Windows NT, MS Windows, AmigaDOS, all UNIX.
Lynx	http://www.cc.ukans.edu/lynx_help/Lynx_users_guide.html	ftp2.cc.ukans.edu	Avail on UNIX and VMS. vt100s.
perlWWW	/pub/w3browser	archive.cis.ohio-state.edu	By Tom Fine. tty-based.
WWW Line Mode Browser	http://www.w3.org/hypertext/WWW/LineMode/Status.html	info.cern.ch:/pub/www/src	By CERN. For dumb terminal.
MS Windows Browsers			
AIR Mosaic Express	http://www.spry.com/sp_prod/airmos/airmos.html	ftp.spry.com:/AirMosaicDemo	By Spry. The demo version is available free and can be registered inexpensively. Works under Windows and OS/2.
Cello	http://www.law.cornell.edu/cello/cellotop.html	ftp.law.cornell.edu:/pub/LII/cello	By Cornell LII.
Galahad for BIX	http://www.mcs.com/~jvwater/main.html		Information eXchange. Available from SimTel and CICA sites for 30-day full version free trial.
I-Comm	http://www.best.com/~icomm/	ftp.best.com:/pub/icomm/icomm100b5.zip	A graphical WWW browser with full modem communication functionality. Does not require any kind of SLIP/PPP connections.
Internet Assistant	http://www.microsoft.com/	ftp.microsoft.com/deskapps/word/winword-public/ia	Word 6.0 add on.
InternetWorks	http://www.booklink.com/proddesc.htm	ftp.booklink.com:/lite	By Booklink. The demo version is free. Can open many simultaneous connections in different windows and display images and pages progressively.

Product Name	URL	Anonymous FTP	Note
NetCruiser	http://www.netcom.com/netcom/cruiser.html		By Netcom.
Netscape	http://home.netscape.com/	ftp.netscape.com:/netscape/windows	See X Windows version.
QMosaic	http://www.qdeck.com/beta/beta-signup.html		Internet Toolbox, HTML Authoring Tools, Web Server.
Sesame (Virtual Places)	http://www.ubique.com/Beta/windows_install.html	ftp.ubique.com:/pub/outgoing/pc/	managed by "Doors" servers. Enables real-time interaction between the information provider and the consumer, and among individuals with a common interest in the information.
SlipKnot	http://www.interport.net/slipknot/whatsnew.html		Has limited features but operates well without a proper Internet connection, i.e., SLIP, PPP or TCP/IP.
SMosaic	http://www.commerce.net/software/SMosaic/	ftp.commerce.net, for authorized users only	encryption and authentication enhancements.
WebSurfer/Chameleon	etmanage/apps/websurfer.html		By NetManage.
WebWorks Mosaic	http://www.quadralay.com/products/products.html		By Quadralay.
WinMosaic	http://www.ncsa.uiuc.edu/SDG/Software/WinMosaic/HomePage.html	ftp.ncsa.uiuc.edu:/Mosaic/Windows	By NCSA.
WinWeb	http://www.einet.net/EINet/WinWeb/WinWebHome.html	ftp.einet.net:/einet/pc/winweb	By EINet.
MS DOS Browsers			
DosLynx	ftp://ftp2.cc.ukans.edu/pub/DosLynx/readme.htm	ftp2.cc.ukans.edu:/pub/WWW/DosLynx	

Product Name	URL	Anonymous FTP	Note
Macintosh Browsers			
MacMosaic	http://www.ncsa.uiuc.edu/SDG/Software/MacMosaic/MacMosaicHome.html	ftp.ncsa.uiuc.edu:/Mosaic/Mac	By NCSA.
MacWeb	http://www.einet.net/EINet/MacWeb/MacWebHome.html	ftp.einet.net:/einet/mac/macweb	By EINet.
Netscape	http://home.netscape.com/	ftp.netscape.com:/netscape/mac	See X Windows version.
Samba	http://www.w3.org/hypertext/WWW/Macintosh/Status.html	info.cern.ch:/pub/www/bin/mac	By CERN.
NeXTStep Browsers			
CERN WWW NeXT Browser/Editor		info.cern.ch:/pub/www/src	
Netsurfer	ftp://ftp.netsurfer.com/pub/next/Netsurfer		By Netsurfer.
OmniWeb	http://www.omnigroup.com/Software/OmniWeb/	ftp.omnigroup.com:/pub/software	
SpiderWoman		sente.epfl.ch:/pub/software	Multithreaded.
E-mail Based Browsers			
Agora		Send request to agora@mail.w3.org	Based on the line-mode browser. If you cannot have full access to the Internet. Beta. Supported.

Product Name	URL	Anonymous FTP	Note
IBM OS2			
WebExplorer	http://www.ibm.net/support/web.html	ftp01.ny.us.ibm.net:/pub/WebExplorer	A multithreaded application. Has a visual map.